

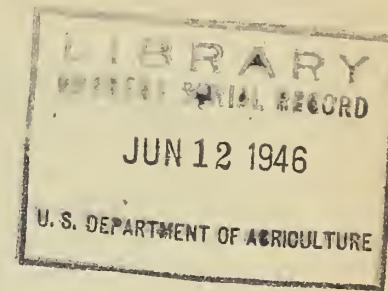
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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Summary Review of Monthly Reports*
for
SOIL CONSERVATION SERVICE RESEARCH**

MARCH 1946



EROSION CONTROL PRACTICES DIVISION

Volunteer Sericea Following Corn - E. C. Richardson, Auburn, Alabama. - "In the spring of 1941, three areas were seeded to lespedeza sericea. On one area the entire growth of sericea together with all the seed were turned in February, 1943 and followed with corn in 1943, 1944, and 1945. In early 1944, two other areas of sericea were turned and followed with corn in 1944 and 1945. A fourth area of sericea, which was planted on the same date was plowed and followed with corn in 1945. This area was plowed for the purpose of following the development of the volunteer sericea seedlings.

"In 1944, 1945, and again in 1946, a fair to good stand of volunteer sericea was obtained each year where sericea was turned in 1943 and 1944 following two and three corn crops. A thick stand was obtained where sericea was plowed in 1945. Results are shown in table.

Volunteer sericea plants following one to three corn crops, Auburn, Alabama, 1946 (Sericea lespedeza planted in 1941)

Date of turning under Sericea	Volunteer stands prior to 1946	Plants per sq. ft., 1946
<u>Year</u>	<u>Number</u>	<u>Number</u>
1943	3	25
1944	2	24
1945	1	169

"Much of the sericea planted four or more years ago is now being overrun with broom sedge. Indications are that discing or some other cultural treatment may be necessary to maintain a productive stand of sericea. Further work is needed to determine the effect of cultural treatments and to what extent fertilizer treatments will increase the yield and life of a planting."

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**All Research work of the Soil Conservation Service is in cooperation with the various State Experiment Stations.

Residues Reduce Soil Loss and Increase Yields of Peanuts and Cotton -
B. H. Hendrickson, Watkinsville, Georgia.-"The accompanying table shows that on Class II sandy land, residues reduced soil loss, usually reduced water loss, and raised the peanut and the cotton yields. On the more erosive Class III land, for 1945, soil losses on cotton land show an amazing range. On land depleted by 3 years of continuous peanut production the soil loss was more than 35 tons per acre. After lespedeza in rotation soil loss was a little more than one ton per acre, and the cotton yield was more than doubled. Harvested legume crops in both cases preceded the cotton. But the peanuts left no residues; the lespedeza did. Twenty-six times as much erosion, just because the peanut land was out-of-condition and had no crop residue protection."

Runoff, erosion and yield per acre of peanuts and cotton with different preceding crops and residues, 1944 and 1945. Watkinsville, Georgia

Year 1/	Crop	Previous Crop	Runoff	Erosion	Yield Per Acre
<u>Class II Sandy Land, 3 per cent, 105 foot slopes</u>					
1944	Peanuts	Peanuts (no residues)	16.4	5.2	1148
1944	Peanuts	Oats-vetch hay stubble and crotalaria turned under	14.9	1.9	1850
1945	Peanuts	Peanuts continuous (no residues)	11.1	7.3	1353
1945	Peanuts	Oats-vetch hay stubble and crotalaria turned under	5.0	1.3	2205
1944	Cotton	Cotton (stalks turned under)	16.8	5.7	851
1944	Cotton-Vetch	Corn-crotalaria (residues turned under)	19.3	4.3	1107
1945	Cotton	Cotton (stalks turned under)	10.8	3.8	797
1945	Cotton-Vetch	Corn-crotalaria (residues turned under)	8.2	2.2	884
<u>Class III Land, 7 per cent, 70 foot slopes</u>					
1944	Peanuts	Peanuts 2 yrs., no residues	22.3	38.3	1192
1944	Cotton	Continuous cotton (stalks turned under)	24.1	27.8	913
1944	Cotton-Vetch	Corn-crotalaria residues turned under	24.8	19.1	945
1945	Cotton	Peanuts 3 yrs., no residues	20.9	35.4	420
1945	Cotton	Continuous cotton (stalks turned under)	17.0	17.6	591
1945	Cotton-Vetch	Corn-crotalaria (residues turned under)	10.7	6.1	916
1945	Cotton	Oats-Kobe lespedeza combine stubble turned under	5.5	1.4	999

1/ The year 1944 was one of average erosion while 1945 was only mildly erosive.

Tobacco Row Layout - T. L. Copley, Raleigh, North Carolina.-"The Extension Service is giving considerable emphasis to the use of contour tillage in the tobacco counties and is pushing the use of our "String Method" of row layout.

"A field trip on March 21-22, with the District Agent of the Agricultural Extension Service and the Extension Soil Conservationist included Elkin, Stokesdale, Prospect Hill and Epsom. At each of these places a meeting was held to discuss the different phases of contour tillage for tobacco land, and this was followed by a field meeting to demonstrate the method of laying out tobacco rows, using the "String Method." Each meeting was attended by County Agents and Soil Conservation Service technicians from approximately four counties."

Earthworms a Factor in Soil Aggregation - Henry Hopp, Beltsville, Maryland.-"The pellets excreted by earthworms appear from our recent studies to be an heretofore overlooked source of erosion-resistant aggregates in soil. Water-stable aggregates larger than 1/2 mm. made up 12.0 per cent of the weight of silt loam soil incubated in the laboratory with worms present and only 5.9 per cent with worms absent. Drop tests on the aggregates also showed a difference in stability in favor of those formed by worms. The earthworm aggregates were about twice as resistant to water-drop impact as the aggregates formed without worms. The quantity and size of aggregates produced by three species of earthworms were:

Species of Earthworm	Average weight per earthworm (grams)	Quantity of soil aggregated per worm-day (grams)	Average diameter of aggregates (mm.)
Lumbricus terrestris	2.10	2.2	3.3
Helodrilus caliginosus	1.23	.5	2.4
Helodrilus foetidus	.49	.3	2.0

"Worm populations of 250,000 per acre were found in lespedeza fields. Such a population would be capable of aggregating perhaps 500 pounds per acre of soil daily based on the rates shown in the above table."

Honey Locusts Provide Erosion Control and Feed Production - Joseph C. Moore, Auburn, Alabama.-"Honey locust trees interplanted with lespedeza sericea control erosion on rough hillsides and produce large quantities of nutritious feed for livestock. The Millwood and Calhoun honey locust are both thornless selections and produce high yields of nutritious beans.

"The dairy department of Alabama Polytechnic Institute ran a feeding test with ground beans and concluded that they were equivalent to oats, pound for pound in a dairy ration. These beans have been fed to hogs, cows and mules on the Hillculture farm at Auburn, Alabama with excellent results without grinding. Our planting was made in 1938 and the average yield of pods for the last four

years have been equivalent to 100 bushels of oats per acre per year + 2 1/2 tons of lespedeza sericea hay per acre per year.

"Honey locusts are propagated by planting seed and budding the desired variety on to the seedlings very much like propagating peaches. The trees should soon be available at prices ranging around 50 cents per tree.

"A combination of honey locust and lespedeza sericea has the following advantages:

1. Rough rolling land is completely protected.
2. High yields of food are produced.
3. Low labor requirements.
4. Good grazing obtained after the trees are large enough to prevent livestock from browsing the young growth.
5. Bitter-weeds and other pests controlled."

Manured Red Clover Lacks Nitrogen - Richard M. Smith, Morgantown, West Virginia.-"Manure application, as noted in previous comparisons, has resulted in somewhat greater growth but the red clover is not so green as with the L P K treatment alone. Analyses of the clover from last year's harvest on three soils shows that the manured clover was lower in nitrogen than the non-manured, although the manured made more total growth, and the yellowing was not so clearly evident as in the present crop. Analyses of the clover from last year follows:

Soil	Treatment	Per-Cent Protein
Acid upland subsoil	LP	20.9
	LPK	20.6
	LPK Manure	18.8
	None	21.0
Atkins surface soil	LP	21.5
	LPK	22.3
	LPK Manure	18.6
	None	21.0
Hagerstown clay subsoil	P	14.3
	PK	21.0
	PK Manure	20.4
		17.1

"The exact explanation for this apparent deficiency of nitrogen in inoculated clover where manure was used is not clear, but may be due to such a rapid growth of the clover that nitrogen fixation was not able to keep up. In the field, clover on mulched or manured plots sometimes appears yellow, probably reflecting the same situation. Early nitrogen fertilization would probably be beneficial under such conditions."

Contour Corn Yield Increase Related to Slope and Soil Permeability - Dwight D. Smith, Columbia, Missouri.-"The yield ratio of contour-planted corn to up-and-down-hill planted corn has been studied in relation to permeability numbers and land slope. A formula was developed from the correlation of these

factors in data from Missouri and Iowa for the three-year period 1943 to 1945. 1/ The index of correlation was 0.31, which is highly significant for the 163 cases included.

"Yields on the impermeable soils in periods of excess rainfall frequently are decreased by contouring. Yield decreases have not occurred on rapidly permeable soils. These open soils are generally on the steeper slopes and are more easily eroded. This results in high stand reduction on these slopes and consequently high yield reduction on up-and-down-hill planted corn over contour planted corn.

"The percent yield increase by contour planting over up-and-down-hill planting on a few of the more common soils of the State determined by the equation are as follows:

Soil	Average land slope <u>Percent</u>	Permeability number	Estimated yield increase <u>Percent</u>
Knox	12	5	30
Marshall	8	4	16
Shelby	8	3	12
Grundy	4	2	5
Putnam	2	1	2

These figures probably represent average rainfall conditions. With rainfall deviating from normal considerable variation could be expected on either side of the estimated yield increase."

Farm Plans in Peacetime - E. L. Sauer, Urbana, Illinois.-"The February-March issue of Illinois Farm Economics has an article entitled 'Farm Plans for Peacetime Production' which discusses (1) present and recommended land use, (2) estimated needs for soil and water conservation practices, (3) proportion of intertilled crops in corn or soybeans, (4) net income on conservation and non-conservation farms, and (5) obstacles and encouraging factors relating to conservation farm plans and practices.

"In the same issue of this periodical is an interesting article concerning trends in size of farm in Illinois by J. E. Wills of the Illinois Agricultural Experiment Station. It shows the change in average size of farm since 1880 and the changed proportions of farms of specified sizes for five census periods from 1920 to 1940, inclusive. During the 20-year period the number of small farms of less than 50 acres was well maintained; the number of 80-acre and 160-acre farms declined considerably; and farms of more than 260 acres in size increased in number."

$$1/ \log \frac{C}{u} = .0047 + .0018 PS$$

in which C = Contour planted yield in bu. per acre

u = Up-and-down-hill planted yield in bu. per acre

P = Soil permeability number

S = Percent land slope

Soil Loss During the War - George W. Collier, Washington, D. C.-"An attempt to add up the total effects of increased use of soil conservation practices and the increased acreage of intertilled crops during the war is made in War Records Monograph No. 2, entitled "Soil Conservation During the War". It indicates that the increased use of conservation practices between 1939 and 1944 reduced soil losses by 77.6 million tons annually. While this large saving of soil helped to make our record war production of agricultural products possible, it was not sufficient to overbalance the increased soil loss due to larger proportions of intertilled crops and the larger than normal number of intense rains which occurred during that period."

Brush Removal for Pasture Improvement - Harley A. Daniel, Guthrie, Oklahoma.-"Small machines for removing trees and brush for pasture improvement are being studied by Maurice B. Cox. The machines that have been used include the power brush-mower, small mobile saws, and a brush beater. An all metal power-lift buck rake has proved very satisfactory for removing the cut material from the land."

"It appears that no one machine or clearing method will satisfy the requirements for all conditions or types of brush. The requirements for a machine to handle brittle or brushy material such as sage or creosote brush will be quite different from that for tough, taller growing material like blackjack or persimmon. Sage and creosote brush break up very readily under the impact of a beater. Tough material such as buck brush, blackjack and liveoak thickets can be readily cut with a mower. The larger trees require portable saws or axes unless large machinery is available.

"Mr. Cox has prepared a manuscript entitled "Small Machines For Removing Trees and Brush For Pasture Improvement" to be given before the American Society of Agricultural Engineers which meets in Fort Worth April 19 and 20."

Pasture Treatment and Grazing Management Conserves Moisture - C. A. Van Doren, Dixon Springs, Illinois.-"With a total rainfall of 72.19 inches in 1945, approximately eight inches more rainfall was retained on the treated plots when moderately grazed than when severely grazed. Forage production was increased on the treated plots and mutton production was doubled by good grazing management on both treated and untreated plots.

Run-off and Yields from Pastures as Affected by Treatment & Management-1945

Treatment and Grazing	Run-off(1)		Yield in Lbs./Ac.(2)		
	Inches	Percent	Weeds	Forage	Mutton
Lime, phos., severe	20.14	28	2023	3074	108
Lime, phos., moderate	12.62	17	2787	3736	219
None, severe	25.19	35	3303	1405	57
None, moderate	25.73	36	3496	1053	105

(1) Run-off from triplicated plots.

(2) Yields from duplicated plots.

Stabilized Sand Dunes Used for Grazing - C. J. Whitfield, Amarillo, Texas. - "From 1937 to 1941 approximately 1,000 acres of sand dune land and wind eroded pasture in the Dalhart Sand Dune Project were stabilized by leveling, planting cover crops, and grass seeding. The area has been continuously grazed since the fall of 1943. Grazing during the period has been at moderate stocking rates. This area has been a high producing pasture. Due to the wide selection of grasses, steers have made high gains in summer and with the cool-season grasses for early spring grazing this pasture has made an ideal calving pasture for a large ranch. The complete treated area has been completely free from blowing during the spring. One 40-acre check area that was untreated has had some moderate soil movement; however, soil from this area has not damaged the treated site. Weeping lovegrass is giving good results as a stabilizer and its utilization has been especially high during the past winter. Western Wheatgrass and Canada wild-rye are increasing the length of the green pasture season and remain vigorous after five years.

"Low-Cost Grass Seed Broadcaster - A grass seed broadcaster developed by the station is being used on a large scale at the Dalhart Land Utilization Project for seeding grass. Four new broadcasters have been made and several thousand acres are being seeded. This seeder is especially well adapted for seeding rough low priced land where the cost of the seeding operation must be kept to a minimum. Covering of the seed is done with packers and disk-harrows set very shallow. The seeding and covering operation is done at the same time by pulling the covering implement behind the broadcaster."

Inoculation of Winter Legumes - H. O. Hill, Temple, Texas. - "For legume winter cover and green manure crops to be successfully used in this area they must be plowed under by mid-March. This is about the latest that green manure can be turned under with the expectation of getting a good early cotton crop. By mid-March the following legumes had made sufficient growth to provide an effective soil building green manure; hubam clover, melilotus indica, bur clover, emerald clover, Canadian field pea, Austrian winter pea, Dixie wonder pea, and creole pea. Thus, only one-third of the legumes in this test show possibilities for winter green manure and most of these have specific limitations.

"Early seeding and favorable weather conditions in September are essential to establishing good covers of winter legumes. At this time of the year the surface soil is hot and dry. This condition is not favorable to the survival of legume inoculants. Previous studies show that nodulation is stimulated by the presence of phosphate fertilizers in the blackland soils. Considering this fact and the desirability of placing the inoculant below the surface a greenhouse study was conducted varying the placement of fertilizer in relation to the inoculant and in relation to the seed. This study showed: (1) That the inoculant and phosphate fertilizer should be in close proximity. (2) That inoculant, phosphate fertilizer, and seed should be as close together as possible. (3) That inoculant without phosphate does not increase clover growth materially (as previously recorded). These results from the greenhouse study suggest other work under field conditions in (1) Will inoculant live in the surface one-half inch or must it be placed at lower depths where moisture and temperature conditions are more favorable for its survival? (2) Will inoculant live in contact with phosphate for distribution with fertilizer?"

Soil Moisture Penetration - Bruno Klinger, Fort Collins, Colorado.- "During the last week in March, a soil moisture survey in Sherman County, Kansas, showed that moisture had penetrated to a depth of 14 to 15 inches on corn and sorghum stubble. Under wheat stubble, the soil was moist to a depth of about 19 inches, and on fallow, it was moist down to 48 inches or better. Near Burlington, Colorado, moisture under corn and sorghum stubble was somewhat better, penetrating to a depth of about 19 inches."

Dry-farm Tomatoes a Possible Crop for Rotation with Lima Beans - Maurice Donnelly, Riverside, California.- "When experimental work was started at Somis one of the rotations planned for study was a three-year rotation of lima beans, grain hay, and flax. The use of flax was abandoned on account of difficulties of harvesting and threshing and because it has only slight conservation properties. This left an obvious need for another economic crop to include in the three year rotation, a need that has not heretofore been met. Dry-farm tomatoes offer good possibilities of meeting this need. The large vine residue, left after harvest of the crop, can be used to good advantage in stubble mulching. We are now working on a plan to include tomatoes this summer on those fields that have hitherto been in a rotation of lima beans, grain, grain."

Conservation Research Results Published - John Lamb, Jr., Ithaca, New York.- "Experimental work on ways of controlling soil erosion have been under way at Geneva since 1936 and at Marcellus since 1937. Some experiments have been run only two or three years. Results of these experiments are reported in Cornell University Agricultural Experiment Station Bulletin 831 'Experiments in the Control of Soil Erosion in Central New York' which is now available."

DRAINAGE AND WATER CONTROL DIVISION

Hydrologic Studies - L. L. Harrold, North Appalachian Experimental Watershed, Coshocton, Ohio.-"Rain totaling 2.21 inches fell on 14 days well distributed over the month - no one day receiving more than 1/2 inch. Rainfall rates were low and very little runoff from the watersheds occurred.

"Runoff from the conservation-practice wheatland watershed totaled 0.5 inch; that from the prevailing-practice wheatland watershed was 0.1 inch. The difference in this case was due to the differences in soils on the two watersheds. The soil profile on the conservation watershed was less well drained than that on the prevailing watershed. The percolation capacity of the soil profiles was controlling the rainfall-runoff relationship. In the summer time when rain falls at greater rates and when the soil surface tends to seal, the effectiveness of the conservation practice is readily apparent.

"At times of high soil moisture, percolation at the 8-foot depth in the lysimeter and spring stream flow responds quickly to infiltration. Rainfall of 2-1/2 inches on the lysimeters in 1 day caused no surface runoff. All went into the ground as infiltration. Within 12 hours after the rain began, percolation at the 8-foot depth increased greatly. Maximum rate of percolation was 0.1 inch per hour. In 48 hours after the rain began, about 1.8 inches of water percolated from the lysimeters. Also in this same period, 1.6 inches of water flowed in the stream from a 122-acre watershed. Very little of this water was actual surface runoff. Most of it came from seepage flow."

Hydrologic Studies - I. W. Bauer, Central Great Plains Experimental Watershed, Hastings, Nebraska.-"Although precipitation at the meteorological station for March was 1.68 inches, it fell with low intensity, so there was no runoff from any of the watersheds. The month was unusually warm, and with the rainfall at the first of the month, the wheat and grass made a good showing during the month.

"Soil conditions were very good for the seeding of oats the later part of the month. All the oats was seeded and good stands were obtained on all the plots.

A table showing the percent-runoff of precipitation for the various crops during the rainfall season follows:

Table 1
Oats, April 1 - August 1, 1940-45

Year	Straight Row			Contour			Subtilled		
	Rain-fall	Runoff	Per-cent	Rain-fall	Runoff	Per-cent	Rain-fall	Runoff	Per-cent
1940	4.96	0.11	2.21	4.84	0.07	1.4	--	--	--
1941	15.34	2.06	13.4	15.14	1.97	13.0	14.63	1.89	13.
1942	16.48	2.72	16.5	17.68 ^{1/}	3.51 ^{1/}	19.8	16.50	2.32	14.
1943	12.35	2.35	19.0	12.45	1.70	13.6	12.17	2.50	21.
1944	15.64	4.46	28.5	15.50	4.67	30.1	15.42	3.06	20.
1945	13.24	2.75	20.7	13.66	2.26	16.5	13.94	2.52	18.
	Average			16.7			15.7		
	Wheat			August 1 of previous year			- November 1		
1940	12.56	.47	3.7	13.62	.33	2.4	--	--	--
1941	29.49	1.96	6.6	29.99	.94	3.1	--	--	--
1942	39.62	5.28	13.3	39.36	5.40	13.7	38.94	6.19	15.9
1943	27.88	4.68	16.8	28.01	2.95	10.5	27.47	2.01	7.3
1944	29.82	3.37	11.3	29.81	3.64	12.2	28.82	5.20	18.0
1945	30.27	1.86	6.1	30.46	2.36	7.7	30.70	2.34	7.6
	Average			9.6			8.3		
	Corn			April 1 - November 1					
1940	9.12	.34	3.7	8.62	"T"	--	--	--	--
1941	23.52	3.93	16.7	23.07	2.64	11.4	22.32	3.63	16.3
1942	27.30	5.93	21.7	27.35	6.00	21.9	28.56 ^{2/}	10.25 ^{2/}	35.9
1943	14.64	2.86	19.5	14.58	2.32	15.9	14.52	1.16	8.0
1944	25.34	7.49	29.6	25.45	4.00	15.7	24.48	2.45	10.
1945	17.92	1.50	8.4	18.15	1.25	6.9	17.78	1.57	8.8
	Average			16.6			14.4		

1/ 3H only.

2/ Only one plot that had very little cover.

Table 2
Pasture April 1 - November 1, 1940-45

Year	Unfurrowed			Furrowed			Unfurrowed		
	Uncontrolled Grazing			Uncontrolled Grazing			Controlled Grazing		
	Rain-fall	Runoff	Per-cent	Rain-fall	Runoff	Per-cent	Rain-fall	Runoff	Per-cent
1940	9.29	0.54	5.8	9.29	0.01	.1	9.29	0.67	7.2
1941	23.20	1.16	5.0	23.20	.08	.3	23.20	1.08	4.6
1942	27.74	2.28	8.2	27.74	.20	.7	27.74	.71	2.6
1943	14.44	1.25	8.6	14.44	.10	.7	14.44	.72	5.0
1944	24.67	1.71	6.9	24.67	.27	1.1	24.67	.32	1.3
1945	18.06	1.34	7.4	18.06	.20	1.1	18.06	.34	1.9
	Average			7.0			.7		

Table 2 - Continued

Furrowed Controlled Grazing			
Year	Rainfall	Runoff	Percent
1940	9.29	0.01	.1
1941	23.20	.02	.9
1942	27.74	.03	.1
1943	14.44	.02	.1
1944	24.67	.06	.2
1945	18.06	.06	.3
	Average		.3

Table 3

Year	PASTURE 3.74 Acres Uncontrolled Grazing			NATIVE MEADOW		
	Rainfall	Runoff	Percent	Rainfall	Runoff	Percent
1940	9.23	0.39	4.2	9.42	"T"	
1941	22.40	1.45	6.5	23.58	0.20	.8
1942	27.14	1.86	6.8	28.60	.46	1.6
1943	14.10	1.49	10.6	14.74	.03	.2
1944	24.05	2.75	11.4	24.74	.18	.7
1945	17.73	1.75	9.9	17.76	.08	.4
	Average		8.2			.7

Hydrologic Studies - R. B. Hickok, Lafayette, Indiana. - "Average total precipitation was 2.39 inches on the Throckmorton Farm and 2.81 inches on the Dairy Farm. 'Normal' March rainfall is 3.15 inches.

"Light runoff occurred from several of the rotation crop watersheds on the Throckmorton Farm from a rainfall on March 14, of approximately 1.25 inches. The highest water loss from rotation cropland was from 2d-year meadows, exceeding that from fallow land (stalks from 1945 corn crop knocked down). Substantial water losses occurred from the permanent pastures on the Throckmorton Farm.

"Further evidence of the possibilities of high water yields in spring from wooded and grassed lands is given by the following total losses for March from watersheds on the Dairy Farm:

Runoff from Wooded and Permanent Pasture Watersheds^{1/}
March, 1946

Purdue Dairy Experiment Farm, Lafayette, Indiana

Watershed No.	Cover	Runoff	
		Inches	Percent of Precip.
31	Perm. (Bl. gr.) pasture	1.84	66
32	" " " "	1.10	39
33	Pastured woodlot	2.40	85
34	Protected woodlot	1.07 ^{2/}	67

1/ Crosby silt-loam, prevailing soil type.

Average slopes: No. 31 - 8.9 percent, No. 32 - 6.2 percent,
No. 33 - 3.7 percent, and No. 34 - 4.6 percent.

2/ This figure may be in error because the figure on original copy was not legible.

"The above data are typical for these watersheds in spring or after protracted rainy periods when the soils become saturated. The runoff under these conditions is characterized by long durations at low rates and high response to small amounts of low intensity rainfall."

Hydrologic Studies - R. G. White, East Lansing, Michigan.-"As recorded by the Standard U. S. Weather Bureau type non-recording雨量計, precipitation for the month of March measured 2.16 inches at the cultivated watersheds, 2.19 inches at the wooded watershed, and 2.14 inches at the stubble-mulch plots. The 40-year average for March at East Lansing is 2.43 inches.

"There was considerable runoff at the cultivated watersheds during the first part of the month. The runoff was caused almost entirely by snowmelt on frozen soil, and from March 1 to March 6, runoff was almost continuous. At the wooded watershed, there was one small period of runoff on March 5 and 6, caused largely by melting snow. There was no soil

loss at any of the watersheds. Runoff figures for the month are shown in the following table:

Date	Cultivated Watersheds			Wooded Watershed	
	Precipitation	Runoff		Precipitation	Runoff
		"A"	"B"		
Mar. 1-3	0.06	1.0447	1.1627	0.05	0
Mar. 3-6	1.23	.9138	1.2125	0.93	.0726
Total for month	2.16	1.9585	2.3752	2.19	.0726
Percent runoff		90.67	109.96		.03

Hydrologic Studies - D. A. Parsons, Auburn, Alabama.-"The depths to ground water in 18 wells on a 27-acre watershed above an experimental farm pond have been under observation for about a year. The rate of change of mean depth with time, during rainless periods, appears to be negatively proportional to the mean depth. This is to say that the rate of drop of the water table is directly proportional to its elevation.

"For mean depths greater than about 7 feet, the rate of fall is expressed by,

$$u \times 10^5 \frac{dD}{dt} = 2.19 - .0108 D,$$

and for lesser depths by,

$$u \times 10^5 \frac{dD}{dt} = 9.80 - 0.104 D$$

where: u = kinematic viscosity of the ground water, sq.ft./sec.

D = mean depth to water table in inches

t = time in days.

During the summer months, especially at times of relatively high ground-water levels, the rates of fall of the water table are considerably higher than indicated by these expressions. This is undoubtedly due to the use of ground water by vegetation in the lower portions of the watershed.

"Ground-water inflow to the pond ceases when the mean depth to the water table reaches about 7 feet. It may be concluded that the second expression applies to the time that ground-water flow is from the hillsides to the valley above the pond; and the first, to the time when ground water is flowing only to the lower valley or to some other distant destination. The rate of fall changes very slowly with change in mean depth at mean depths greater than 7 feet."

Microbiological Studies - D. A. Parsons, Auburn, Alabama. - "The effect of the method of handling green manure crops upon soil-nitrate level and yield of corn on Cecil clay is shown in the following table. Nitrate values are given only for the period May 15 to June 30, since for the remainder of the year these values were low with relatively little difference between the different treatments.

Green manure crop	Method of handling crop	Average NO_3 content in ppm of soil for the period May 15-June 30				Bushels of ear corn per acre	
		Surface soil, 0-6 inches		Surface soil, 6-12 inches		1944	1945
		1944	1945	1944	1945		
None	plowed	3	2	2	2	11.6	18.4
Crotalaria	plowed under mulch	4	4	2	3	7.4	9.8
Vetch	plowed under mulch	24	16	10	10	41.5	52.5
Oats	plowed under mulch	11	16	6	6	26.6	41.4
		2	3	2	1	23.2	27.7
		3	2	2	2	14.4	24.3

"Only where vetch was used as a green manure did nitrate contents ever reach fairly high levels in the soil. In 1944, nitrate in the surface soil of the plowed-under vetch was double that for the mulched vetch; in 1945 the values were the same for both treatments. In both years nitrate in the subsurface layer of soil (6-12 inches for plowed-under vetch) was about double that for mulched vetch. This was probably largely due to the fact that nitrate from the plowed vetch is formed at a deeper point in the soil and, consequently, is more readily leached into the subsurface layer. Nitrate under crotalaria remained at low values with little difference between the plowed and mulched plots. This situation is probably due to the fact that a large share of the nitrogen in the crotalaria crop is nitrified during the fall and winter, and leached or otherwise lost. Nitrate values under oats were also similar regardless of method of handling residues. They remained low and did not reach values above those found in the no organic matter treatment despite the fact that an extra 40 pounds of commercial nitrogen was added to the oats plots to grow this crop.

"It is of interest to note the nitrate content of the subsurface layer of soil. During the May-June period in the vetch plots nitrate in the 6-12-inch soil layer is equal to one-half to two-thirds that in the 0-6-inch

layer. With other treatments, nitrate in the subsurface layer is approximately equal to that in the surface layer. It is obvious that the nitrate in the subsurface layer of this soil makes up an appreciable portion of that which may be available to plants and should be considered in studies of nitrogen transformations in the soil.

"The principal factor affecting corn yields appears to have been the nitrate level of the soil. Thus the yields on the vetch plots were outstandingly higher than those on any other treatment. An additional factor in the case of crotalaria is the competition of this crop with corn for moisture and nutrients. Corn following oats gave a higher yield than the check plots although the same amount of nitrogen was applied to the corn crop in both cases. This increased yield is probably partly due to an organic matter effect leading to better conditions in the soil of the oats plots and partly to nitrification of part of the nitrogen of the oats crop. The lower yields of corn on the mulched plots can not be ascribed entirely to the lower nitrate accumulation in these plots. With presently available equipment, it has not been possible to obtain a good seedbed by subsurface tillage of the Cecil clay soil on which the plots of this experiment are located. This particularly affected the stand of corn, and in both 1944 and 1945 it was necessary to replant part of the corn on the mulched plots.

"In connection with soil physics studies, numerous methods were suggested for both laboratory and field techniques. Assistance, if needed, can be given by this project on the following determinations:

1. Soil shear resistance
 - (a) Shear vane for field testing.
 - (b) Soil shear values obtained in Soil Conservation Service laboratory at Auburn.
2. Soil porosity
 - (a) Tension table and air pycnometer data.
 - (b) Instrumentation for Holgate laboratory."

Runoff Studies - N. E. Minshall, Madison, Wisconsin. - "The precipitation for Edwardsville was 4.08 inches as compared to a normal of 3.41 inches. There were no high intensities, the maximum hourly amount was 0.40 inch, yet the runoff for the month was 2.5 inches from the 50-acre pastured area. Temperatures varied from a maximum of 80° on the 29th to a minimum of 22° on the 9th, with a mean of 52° for the month, or about 8° above normal.

"Precipitation at Fennimore for the month was 2.78 inches as compared to the normal of 1.90. Rainfall from 5 p.m. to midnight on the 5th amounted to 1.11 inches with a corresponding runoff of 0.85 inch. This high amount of runoff was due to the frozen condition of the soil. A snow storm accompanied by high winds and much drifting occurred on the 8th. The catch for the recording gages in this storm was 0.32 and 0.45 inch. One standard gage, however, which is equipped with a crude type of shield,

collected 0.63 inch. The depth of snow on the ground after the storm was estimated to be 10 to 12 inches. General thaw began at 2 p.m. on March 11 with temperatures of 36° to about 6 a.m. on the 12th, then rising to about 45° by noon and remaining above 40° through the 13th. Runoff on all areas began between 10 and 11 a.m. on the 12th and continued until the entire snow blanket was gone. Light rains amounting to a total of 0.22 inch fell from 7 p.m. on the 12th to 5 a.m. on the 13th. The total accumulated moisture as shown by the highest gage was 0.85 inch; yet the runoff from three watersheds varied from 0.80 to 1.08 inch. Rates of runoff varied considerably between areas during the day, but agreed very well after sunset showing the effect of the exposure of the watersheds on runoff from melting snow. The fact that the runoff on two watersheds exceeded the recorded precipitation indicates that there is considerable error in snow measurements during times of high winds."

Hydraulic Studies - F. W. Blaisdell, Minneapolis, Minnesota.-

"Mr. Donnelly has been continuously engaged in the studies of the rectangular spillway outlet. In the discussion of the rectangular spillway outlet with Mr. M. M. Culp, Civil Engineer in the Regional Engineering Division, last December, it was decided to try to eliminate a small scour hole caused by an eddy which forms at the end of the wingwall. This hole is -0.07 foot deep in the 8-inch wide model and is close to the wingwall but is a short distance beyond the end of the spilling basin proper. This scour occurs after the model has been running for at least an hour. When tests were run for 30 minutes, as they were for the preliminary tests, the scour hole did not appear. It was then decided to run the tests for 4-hour periods in order to make sure that all bed movement had ceased. In an attempt to eliminate the small scour hole next to the wingwall, tests were made on different types of wingwall, by extending the floor of the spilling basin, by using rip-rap, and by changing the longitudinal and end sills. All of these changes gave results that were either worse than or equal to the results obtained when using the original design of the outlet. The problem was discussed with Dr. L. G. Straub, Director of the St. Anthony Falls Hydraulic Laboratory, and the following changes were suggested in order to eliminate the scour hole: Raise the tailwater level and extend the wingwall. Mr. Culp had previously objected to the suggestion that the tailwater level be raised since it would increase the cost of the outlet. The distance that the wingwalls would have to be extended to eliminate the scour hole was so great as to be uneconomical. In an attempt to inject a new viewpoint into the investigation, Mr. Blaisdell personally conducted a short series of tests. Any solution to the difficulty found by either he or Mr. Donnelly was uneconomical or impractical. It was realized before these tests began that the scour was not serious, but it was felt that an effort should be made to eliminate it if it were readily possible. As a result of these tests, it was felt that a small increase in the depth of the cut-off wall would be the most economical solution to the problem. Mr. Donnelly has begun his tests to check the design he has prepared, and it is anticipated that these tests will be completed during the month of April."

Hydraulic Studies - A. W. Marsh, Corvallis, Oregon.-"A thorough study of the land on which new experimental plots are to be established was made and the original experimental design modified to fit the physical conditions. The plot site was staked and certain individual plots on which subsoiling was to be done immediately were located. A plan for irrigating was agreed upon and a survey of present irrigating and water measuring equipment made and additional needs determined. The Bureau of Reclamation will supply the additional measuring equipment needed."

Hydraulic Studies - Vito A. Vanoni, California Institute of Technology, Pasadena, California.-"Tests of a model of Rock Eagle Lake Spillway at Eatonton, Georgia, were completed. This structure, which has a design discharge of about 2,000 cfs., presented several problems. The flow over the crest is directed towards the left wall of the structure, creating a very asymmetric flow distribution in the chute. The chute section is trapezoidal in shape with a 30-foot bottom width and 2:1 side slopes. The chute section goes around a curve with a 150-foot radius. One of the most important problems in connection with the spillway is to conduct water around this curve without excessive superelevation and to discharge it into the stilling basin as uniformly as possible. In the existing structure this is accomplished with deflector blocks 18 inches high, which attain this objective very well. However, they are too high and cause air pockets to form behind them, which may give rise to periodic disturbances. A system of deflector blocks was worked out which turned the flow satisfactorily and did not form air pockets. Considerable improvement in the performance of the stilling basin was also obtained by using a warped transition section between the sloping walls of the chute section and the vertical walls of the stilling basin."

Sedimentation Studies - Carl B. Brown, Washington, D. C.-"In the Central Valley, Calif., investigation of reservoir silting, the detailed survey of Exchequer Reservoir was completed and sediment samples were collected for laboratory analysis. Reconnaissance conservation-survey mapping was completed on the watersheds above the proposed Success and Terminus reservoirs and some mapping was done above the Isabella dam site. Considerable field reconnaissance work was done to obtain pertinent data on other reservoirs and diversions canals throughout the area.

"Preliminary plans were prepared for a resurvey of sedimentation in Lake Decatur, the municipal water supply reservoir of Decatur, Illinois. The first sedimentation survey was made in April 1936, and a resurvey has been requested by city officials to determine the extent of additional sedimentation during the past 10 years.

"An article on 'Sedimentation and Its Control' for the 1943-47 Yearbook of Agriculture was revised and submitted to the Department. Mr. Gottschalk prepared a paper entitled 'A Method of Estimating Sediment Accumulation in Stock Ponds' for presentation at the forthcoming meeting of the American Geophysical Union. This paper was based on the results of investigations

on the silting of stock ponds on the Land Utilization project near Pierre, S. Dak. Data on the SCS sedimentation surveys of San Carlos Reservoir, Coolidge Dam, Ariz., were prepared and transmitted to the United States Engineer Office, Los Angeles, Calif. Assistance was rendered to the United States Geological Survey in preparing inventory data on reservoirs in the Columbia River basin and the Missouri River basin."

Sediment Studies - Vito A. Vanoni, Cooperative Laboratory, California Institute of Technology, Pasadena, California.-"Further time was devoted to the numerical integrations of the mathematical functions that will give the rate of transportation of sediment in suspension for various velocities and depths of flow. The sediment load calculated in this manner will be added to the load given by the bed-load formulas in an attempt to derive a new formula that will give the total load of the stream when the rate of transportation is high and much of the material is transported in suspension.

"Some progress was made in the preparation of a manuscript on 'Thermal Density Currents of Shaver Lake' for publication in the Transactions of the American Geophysical Union. A paper covering the same material was given by Mr. Bell to the meeting of the Union in Sacramento in February.

Drainage Studies - Lee D. Dumm, Athens, Georgia.-"Supplemental irrigation plots were staked out and all plots were double disked twice in an attempt to kill out obnoxious weeds, Bermuda and Johnston grass. All corn and truck plots and about three fourths of the irrigated pasture plot were turned with a mold-board plow in preparation for application of lime and fertilizer. This plowing was done during the latter part of the month and was stopped by excessive rains which caused the Middle Oconee River to overflow its banks and partly inundate the plots.

"A considerable amount of work was done toward completing computations of data for the Climatological Report and a rough draft of the report is partially completed. It is hoped that this report will be completed within a short time so that it may be checked and edited by both the University of Georgia and Soil Conservation Service officials. These data will be published by the Agricultural Engineering Department, College of Agriculture, University of Georgia when all final approval has been received."

Drainage Studies - C. Kay Davis, The Everglades Project, Fort Lauderdale, Florida.-"The water level in the open 'glades is about as low as it was at this time last year but fortunately we have not had very many fires so far. The rainfall in the Belle Glade area is about normal. In fact, the normal rainfall for the months of January, February, and March, is 6.44 inches and up to April 1, we have recorded 7.87 inches.

"The Army Engineers have opened the St. Lucie and Caloosahatchee canals to full capacity and expect to lower the Lake to elevation 15 in anticipation of summer rains beginning during the month of June. The Lake level is now 16.35 (Okeechobee datum).

"The dams constructed in Dade County are showing excellent results. The one in the Tamiami Canal, however, is causing some unhappiness among those who constructed buildings in the low areas during the past 3 years when the water table was very low. The dam in the Tamiami canal is now holding the water table to the elevation recorded in 1941 when we had an average rainfall and it is encouraging to note that the Water Authority Commission is giving 100 percent support to the decision of the engineers."

Drainage Studies - M. H. Gallatin, Homestead, Florida. - "Moisture blocks were put in on four different areas during the latter part of the month. Two of these areas, one in limes, and the other avocados, will be carried on in cooperation with Mr. Brooks. On these two areas the avocado block has six 2-1/2-acre irrigation blocks and the citrus area four 2-1/2-acre blocks. In the avocado plots we are at present using two of the 2-1/2-acre areas for our moisture work. One series of moisture blocks are in the non-irrigated plot; and the other in the irrigated plot. The rest of this area will be used for nitrate and the other fertility studies. This same scheme will be carried out on the lime block.

"Then, two more areas, one in avocados and the other in citrus, were put out on the station land. Several other areas will be selected covering other variations in the Rockdale Rockland series for moisture studies.

"During the latter part of the month Mr. Brooks, with whom we are cooperating on irrigation, moisture, and fertility studies, put in a well on a cleared and scarified piece of land where we can move and check all the types of systems being used. It would have been difficult to move our equipment from grove to grove, and having this area makes it possible to set up our gages for checking, distribution, and intensity, and to check all types of equipment under the same conditions. Our installation can be semi-permanent in nature until we have collected data on all equipment.

"Rainfall for the past month over this area has been excessively low. On the first of the month 0.89 inch of rainfall was recorded at the Mowry Street gage and the Subtropical Experiment Station. Since that time only one shower of rain of 0.05 inch was recorded up to March 29. On March 29, a rain of 2.24 inches at the Mowry Street gage and 2.23 inches at the Subtropical Station was recorded. Up to the reading on March 26, there has been a definite reversal of the trend or pattern of the water table established in the past month or two. In the past the drop in water table through the central portion of the Rockdale area has been greater than for that portion adjacent to and out in the marl area. The readings for this month to the 26th of March show a loss of approximately 1.0 to 1.2 feet for the marl area and lower Rockdale area, while for the central portion the loss in water table has been around 0.2 to 0.3 of a foot. Then on the upper end of the area the drop in water table again increases, and a drop of 1.1 foot was recorded at the last station.

"The lowest reading recorded at Highlands plots was 0.25 of a foot above mean sea level. If this condition had continued we probably would have had some minus readings.

"On March 29 a rainfall of 2.24 inches was recorded at the Mowry Street gage and 2.23 inches at the Subtropical Experiment Station. Reading the wells on March 29 indicated that this rain did not cover the entire Rockdale and Marl area. In the southern portion at Well E-32 located at the Highlands plots, a rise of 1.16 feet was recorded. This decreased northward on Redland road, and at Well No. 11 there was a drop in the water table. Then as the 'glades' were approached we again had slight rises in the water table. From the effect on the water table it is believed that this rain fell in the northern and western part of this area.

"It is anticipated that the intrusion studies on the undeveloped land will be started in the near future. We shall set up regular sampling lines in the cultivated area the first of the month. Along this line we have during the past week set up a sampling area along the Tamiami Canal in the northwest section of Miami. The sampling for chlorides over this area will be carried out periodically until structures to hold out chlorides have been installed. Sampling on March 26 showed chlorides varying, through this area, from nearly nothing to 50,000 p.p.m.

"In general, when the concentration of chlorides in the surface 2 inches is around 4,000 to 5,000 p.p.m., there is a distinct depression of growth of most truck crops.

"Several of the locations samples were as follows:

<u>P.P.M. Chloride</u>	<u>Crop</u>	<u>Notes</u>
15,682	cabbage	Wilted and dried up
38,090	potatoes	Vines dead
12,626	strawberries	Dead vines
7,630	broccoli	Some wilting
3,315	potatoes and strawberries	Wilting and drying

Drainage Studies - R. E. Morris, North Liberty, Indiana. - "A survey was made of a 20-acre plot at the north end of the Purdue Muck Farm with the idea of putting in rather closely spaced open ditches as a means of more effectively draining that area. The field in question is leased land and the University has not cared to place tile in land which they do not own. They have avoided open ditches in the past because of the weed-control problem. Chemical weed control is now becoming practicable and thus discounts one of the objectionable features of open ditches. Farm operators who are not in a position to install tile drains, or those who farm impervious clay soils in which tile are ineffective, will be interested in these trials.

"Large and small scale growers in this area continue to show increasing interest in the water-control experiments. Those in the Kankakee Valley have become quite pessimistic concerning the possibility of the Kankakee River being cleaned in the near future. Therefore, many of them are planning to build private levees and solve their immediate drainage problems by pumping."

IRRIGATION DIVISION

Evaporation, Transpiration and Seepage Losses Affecting Irrigation Practices - High Plains of Texas. -Dean W. Bloodgood reports that recent readings by the Geological Survey of ground-water elevations on the High Plains of Texas, show that the water table in most of the areas is from 2 to 5 feet lower than a year ago. This is strictly a pumping area (about 4,500 pumping plants and about 500,000 acres of land being irrigated) where we plan to carry on some measurement-of-irrigation-water investigations.

Texas Rice Requirements. -Dean W. Bloodgood reports selection of three farms in the Katy area near Houston, which are considered suitable for the measurement of irrigation water and representative of the soil types of the area. The studies will probably start about the middle of May when the rice-irrigation season begins. The areas of the farms selected range from 160 to 350 acres (all rice) and the capacities of the pumping plants range from 1,000 to 2,000 gallons per minute. It is planned to measure the water with weirs and recorders. The irrigation season ranges from 60 to 120 days and the pumping plants are run continuously.

Imperial Valley Irrigation Practice. -W. W. Donnan reports 5 more irrigation trials on Imperial Valley plots having different lengths of run, crop types, soil types, and heads of water in connection with the analysis of irrigation practices. A 160-acre farm plot having tile lines spaced at 390 feet was investigated in a continuing study related to the tile-spacing formula project. In the laboratory, runs were inaugurated in the tile spacing tank on stratified soils. This phase of the tile-spacing research is complementary to the phase just completed on homogeneous soils.

Water Application Efficiencies. -A paper on "Water Application Efficiencies in Irrigation", by Orson W. Israelsen and Harry F. Blaney was presented by Mr. Blaney at the South Pacific meeting of the Section of Hydrology, American Geophysical Union, at Sacramento, California.

Big Horn River Problem. -J. S. James reports that work with Operations on the Big Horn Soil Conservation District has raised the question of modification of water-requirement estimates and of recommended irrigation practices in consideration of the use of relatively high saline water. Indications are that the salt content of the water during the spring and early summer runoff may be so low as to be negligible, but during the late summer, the flow is made up in large part of return-flow from irrigated areas upstream in Wyoming. This return flow includes the flow of drainage ditches from some strongly alkaline areas and probably has a high salt content. It is hoped that definite information on the salinity of Big Horn River water may be found. Such information might modify recommendation for irrigation practice in the area. Seriousness of the situation is lessened by the early prospect of additional storage on the upper stream. Such storage should dilute the low-water flow, and will probably remove any serious hazard in the use of this stream for irrigation.

Santa Ana River, Calif..-Dean C. Muckel reports preliminary estimates of the amount of water now being consumed annually by riparian vegetation in Santa Ana Canyon and the amount of water which can be salvaged. Of the total consumptive use of 3,000 acre-feet, 1,400 acre-feet can be salvaged and put to beneficial use during the irrigation season. If, as has been proposed, the summer flow of Santa Ana River is eventually canalized between the two existing canal intakes and pumping is resorted to so as artificially to lower the ground-water level, there will be approximately 800 acre-feet of water made available from ground-water storage in addition to that saved by reducing the consumptive use.

Evaporation from Water Surfaces.-A. A. Young reports further compilation of evaporation data for California, with the number of records increasing steadily. They include records for all types of land and floating pans at elevations from below sea-level to 7,000 feet elevation. Included are records from covered reservoirs, evaporimeters, salt water and fresh water, and computed evaporation from lakes where the only loss is by vaporization. Results of evaporation experiments at Salton Sea and elsewhere in California will be a part of the report. Evaporation data collected at the numerous storage reservoirs throughout the state and other agencies insure a comprehensive coverage of records.

Snow Surveys and Water Supply Forecasts.-J. C. Marr reports a conference with the district engineer of the Geological Survey at Tocoma, regarding snow-survey schedules for snow courses along the Cascade Mountains. It appears that the power companies in coastal cities have requested more frequent snow surveys during the winter, and it was decided that we will make every effort to measure these courses once each month from January to May, inclusive.

J. C. Marr reports making the 50-mile trip from McCall to Secesh Summit with the sno-plane, in company with W. D. Criddle. Ordinarily this trip and the snow surveys at Squaw Meadow and Secesh Summit requires 3 days, or if it is done without stopping, 26 hours. On this occasion the entire job was done in 3 hours and 4 minutes. The trip was made during the early morning hours when the snow was hard. Later in the day it would have been impossible.

Design, Invention and Testing of Irrigation and Drainage Apparatus.-R. L. Parshall reports that the 9-inch portable form for casting small reinforced monolithic Parshall measuring flumes is now completed and incorporates a number of improvements over the design of previously built forms. The present structure offers ease in assembly, alignment, setting to exact grade, the removal of the pieces after the flume structure has been cast, and other changes all having to do with the efficient use in the field.

Studies of Customs, Regulations and Laws Affecting Farm Irrigation and Drainage - Studies of Irrigation Enterprise Organization. -Wells A. Hutchins reports further work preparatory to the sampling process. Before taking the sample, a card will be prepared for each enterprise in the West serving 2,000 or more irrigated acres for which adequate data are available. This includes name, location, and character of enterprise, area irrigated, acreages in various crops, and percentages of irrigated crop acreages. Considerable time was spent on the selection of enterprises from which the sample will be taken, and in making necessary computations. Several test schedules were taken of enterprises in California in February and March. These were critically reviewed and conferences were held with BAE personnel concerning the results.

J. S. James and O. W. Monson went over plans for an irrigation research project in Montana, considering principally a project to be located in lower Yellowstone Valley with two main objectives: (1) The observation and evaluation of land development, including grading or heavy leveling, and (2) the observation and recording of significant conditions in actual irrigation practice as found on established farms and as being worked out on new farms, with the benefit of technical advice.

W. D. Criddle reports that several days were used in preparation for and in giving a discussion on irrigation at the Soil Conservation Service Training School at Pocatello, Idaho. Some preliminary data from studies made in the Yellowstone Soil Conservation District in eastern Idaho were presented at this meeting. On farms studied, the irrigation efficiencies varied from 25 to 44 percent, and the percolation rate of water into the potato furrows varied from about 2 to 6 acre inches per acre per day, which is relatively slow.